

# RESERVE COPY

## PATENT SPECIFICATION



Application Date: Aug. 16, 1939. No. 23659/39.

532,347

Complete Specification Left: Aug. 15, 1940.

Complete Specification Accepted: Jan. 22, 1941.

### PROVISIONAL SPECIFICATION

#### Improvements in or relating to Folding Doors, Partitions or the like

We, GEO. W. KING LIMITED, a British Company, of Hartford Works, Hitchin, in the County of Hertford, and DONALD MAYER KING, a subject of the King of Great Britain, of the aforesaid Company's address, do hereby declare the nature of this invention to be as follows:—

This invention relates to folding doors, partitions or the like and it has for its chief object to evolve a construction which is particularly adapted for application to buildings having large entrance openings such as in the case of aircraft hangars or the like.

According to the invention a folding door, partition or the like which is adapted to be moved back and forth along a predetermined path to open or close an entrance or exit and is formed of a plurality of leaves or the like which are hingedly interconnected has means associated therewith adapted to ensure that the leaves will be maintained vertical during movement and at all other times. In those cases where the span is considerable or where for other reasons it becomes necessary the door may be made in two or more independent folding sections and in such cases means are associated with each section adapted to maintain the leaves thereof vertical at all times.

In accordance with a further aspect of the invention power operated means are provided for effecting operation of the folding door or door sections, while preferably hand operated means for such purpose are also incorporated.

One embodiment will now be described with reference to a single folding door or partition which comprises in known manner a plurality of leaves which are hingedly interconnected in such a manner that they may be folded back one on the other and when required drawn out or extended to close the entrance or exit to which the door is applied. At alternate lines or axis of folding of the leaves means such as swivelling rollers or the like are provided at the upper and lower edges of the door, which means are adapted to co-operate with suitable upper and lower tracks and to ensure that the door will move back and forth in the required path.

In known manner the leaf at one end of the door section is hingedly connected to a fixed door post or the like, while the leaf at the opposite end of said door section is hingedly connected with a movable door post or mullion, hereinafter referred to as a mullion, adapted to slide with the leaves between the upper and lower tracks. While the leaves will be maintained vertical in one plane due to the co-operation of the swivelling rollers or the like with the upper and lower tracks there is a tendency, on opening or closing of the door, for the mullion and said leaves to tilt or cant in the other vertical plane due to unequal movement between the top and bottom of the door. It is one object of the invention to overcome this difficulty and to ensure equal simultaneous movement of the upper and lower parts of the door and for this purpose two pairs of sheaves or pulleys are mounted on the mullion, one pair being disposed at or adjacent the upper part and one pair at or adjacent the lower part thereof. Suitably anchored at one end, for example to the upper part of the fixed door post, is a rope or cable which is adapted to pass over a sheave or pulley at the upper part of the mullion and then downwardly around a sheave or pulley at the lower end thereof, the other end of said rope or cable being suitably anchored at the extremity of movement of the mullion, such as to a fixed door post at the opposite end of the opening in which the door or partition is disposed. A second rope or cable is suitably anchored at one end at the lower part of the first fixed door post and is adapted to pass around the second sheave or pulley at the lower part of the mullion and then upwardly over the second pulley at the upper part of said mullion, the other end of said second rope or cable being suitably anchored at the extremity of movement of the mullion and preferably in the same vertical plane as the second point of anchorage of the first rope or cable. The sheaves or pulleys may be mounted in any suitable manner on the mullion while means are preferably associated with the ropes or cables at the points of anchorage thereof in order to allow for adjustment

of the tension thereon. By virtue of the action of the ropes or cables any possibility of movement of the mullion and hence of the leaves from the vertical 5 during movement back and forth along the track and at all other times will be prevented. Instead of providing only two ropes or cables in the manner above described it may be preferable to provide 10 an independent and separate set of guiding ropes or cables at both the upper and lower ends of the mullion. In this case two pairs of sheaves or pulleys would be mounted at the upper end of the mullion, 15 one pair being disposed above the other while a similar arrangement would be provided at the lower part of said mullion. Considering now the upper end of the mullion, one rope or cable would be connected or anchored to the upper part of the 20 fixed door post and would be led around one of the upper sheaves or pulleys and then around one of the lower sheaves or pulleys which are, however, disposed at 25 the upper part of the mullion, the other end of said rope or cable being suitably anchored at the extremity of movement of the mullion. The second rope or cable would be suitably anchored to the fixed 30 door post at a point below the point of anchorage of the first and would pass around the second lowermost pulley and then upwardly over the second uppermost pulley, the other end being 35 suitably anchored at the other extremity of movement of the mullion and preferably in line with the point of anchorage of the second end of the first rope or cable. An identical 40 arrangement of ropes or cables would be provided at the lower part of the door and thus the arrangement previously described would in fact be duplicated, separate and independent sets of guiding 45 ropes or cables being provided in respect of both the upper and lower ends of the mullion. Here again suitable means are preferably provided to allow for adjustment of the tension on the ropes or cables 50 in order to ensure that the mullion and hence the leaves will be maintained absolutely vertical during movement and at all other times.

Means are preferably provided for 55 operating the door and in one embodiment the lower end of the mullion is operatively connected in any suitable manner to an endless band or cable disposed in a channel or the like below the path of movement of 60 the door, the arrangement being such that on a drive being imparted to one of a pair of drums carrying the cable the mullion, and hence the leaves, will be moved in one direction or the other according to the 65 direction of rotation of the drum. In another example an endless band carrying a plurality of transverse slats may be disposed in a channel or the like below the path of movement of the door, said band, which is, for example, in the form of a known slat conveyor, being adapted to be driven in any suitable manner. The slat conveyor is preferably slightly longer than the path of movement of the door and a predetermined number of adjacent slats are adapted to carry an upstanding strip or the like substantially centrally thereof, the arrangement being such that when all or certain of the slats carrying the strips are in the same flight of the conveyor an upstanding rail will be formed which extends lengthwise along the conveyor. Said conveyor is so arranged that when in the upper flight the rail thus formed will provide a track on which the rollers or the like associated with the lower ends of the leaves of the door are adapted to run. The lower end of the mullion is connected to the slat conveyor in any suitable manner at a point adjacent one end of the rail and the arrangement is such that if the door is in its retracted or folded position then on operation of the slat conveyor the mullion and hence the leaves will be moved across the door opening. As the conveyor moves along, those slats carrying the strips or the like will be caused to pass successively into the upper flight so that the rollers associated with the leaves will be caused to run on the rail thus formed. As above indicated the slat conveyor is preferably so constructed that only a certain number, for example half, of the slats will carry the strip or the like so that when the door is in its retracted 95 or folded position the channel or the like in which the conveyor is disposed will be closed by slats having a plane surface. The conveyor chain or band carrying the slats may be supported at spaced points by 100 means of rollers or the like which are adapted to co-operate with suitably disposed rails or supports mounted in the channel. In another embodiment the mullion may be driven through the medium of a tractor unit associated therewith and mounted for example at the lower end thereof. The tractor unit may 105 for example comprise a single driving wheel or roller having a central rim or flange adapted to engage a channel or the like in the floor or other surface which also constitutes the lower track in which the rollers associated with the lower ends of the leaves are adapted to run. The driving 110 wheel or the like may carry a rubber or other suitable tyre or rim and may be driven in any suitable manner, for example by means of a two or multiple speed electric motor which is preferably mounted 115 120 125 130

on the mullion itself. The current to the motor may be supplied by providing suitable contactors or the like at the lower end of said mullion adapted to co-operate with bus-bars or the like disposed in the channel, or if desired leads may be taken from a suitable source of supply around a winding drum or the like to said motor, the arrangement being such that as the 5 mullion moves the leads will be wound in or paid out according to the direction of movement of said mullion.

If desired, the arrangement may be such that all parts, such as the sheaves or 10 pulleys, the motor and tractor unit, where such are present, and other elements associated with the mullion, may be totally enclosed therein, while the ropes or cables may be disposed in suitable channels or 15 ducts at the upper and lower edges of the door, which channels or ducts may form the upper and lower tracks in which the rollers associated with the leaves are adapted to 20

run. Further, in certain cases the driving means may be associated with the upper 25 part of the door, while preferably, in addition to any power operated drive, any suitable hand operated means may also be provided to effect operation of the door should the power operated means fail or 30

The invention has been described above with reference to a single door but it will be understood that in certain cases a plurality of such doors or door sections 35 may be provided, for example in those cases where the entrance or exit is of considerable width as in the case of an aircraft hangar.

Dated this 16th day of August, 1939.

HASELTINE, LAKE & CO.,  
28, Southampton Buildings,  
London, England, and  
19-25, West 44th Street, New York,  
U.S.A.,  
Agents for the Applicants.

#### COMPLETE SPECIFICATION

#### Improvements in or relating to Folding Doors, Partitions or the like

40 We, GEO. W. KING LIMITED, a British Company, of Hartford Works, Hitchin, in the County of Hertford, and DONALD MAYER KING, a subject of the King of Great Britain, and of the aforesaid Company's address, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

50 This invention relates to folding doors, partitions or the like and it has for its chief object to evolve a construction which is particularly adapted for application to buildings having large entrance openings 55 such as in the case of aircraft hangars or the like.

According to the invention in a sliding door, partition, or the like including one or more folding sections each formed of a 60 plurality of hingedly connected leaves and adapted to be moved back and forth along a predetermined path to open or close an entrance or exit, bracing ropes, cables or the like are associated with each section, 65 each rope, cable or the like being anchored at its opposite ends and adapted between its points of anchorage to pass around sheaves, pulleys or the like carried by a movable door post or mullion, associated 70 with the leaves in such a manner as to exert a diagonal bracing action on said mullion, the arrangement being such that the mullion and hence the leaves will be maintained vertical during movement and

at all other times. Preferably power 75 operated means are provided for effecting operation of the folding section or sections, while hand operated means for such purposes may also be incorporated.

In order that the said invention may be 80 clearly understood and readily carried into effect the same will now be more fully described with reference to the accompanying drawings, in which:—

Figure 1 shows in elevation a folding 85 door which includes two independent folding sections constructed in accordance with the invention;

Figure 2 is a plan view of the arrangement shown in Figure 1;

Figure 3 shows a detail of construction;

Figure 4 shows a system of bracing the door sections for the purpose of maintaining the same vertical;

Figure 5 shows in side elevation a driving or tractor unit for operating a door section, and mounted in position therein;

Figure 6 is an end view of the unit shown in Figure 5, removed from the door section.

Referring to the drawings, 10 denotes two identical folding door sections adapted to close a door space, each section comprising in known manner a plurality of leaves 11, which are hingedly inter-connected in such a manner that they may be folded back one on the other (as indicated at the right hand side of Figures 1 and 2), and when required drawn out or

extended to close the door space (as indicated at the left hand side of Figures 1 and 2). At alternate lines or axes of folding of the leaves of each door section 5 means, such as swivelling rollers or the like, are provided at the upper end lower edges of the section which means are adapted to co-operate with suitable upper and lower tracks and to ensure that the 10 sections will move back and forth in the required path. One set of rollers for application at the appropriate points to the upper and lower edges of each door section is shown in Figure 3 wherein 12 denotes 15 a roller which is mounted for free rotation about a spindle 13, the latter being carried by a bracket 14 secured to the upper part of the door section at the appropriate part thereof. The roller 12 is adapted to run in 20 a track formed by two channelled irons 15 arranged back to back, the track thus formed constituting an upper track which extends along the length of the door opening. 16 denotes a roller which is mounted 25 in a swivelling bracket 17 which latter is, in turn, mounted for swivelling movement in a further bracket 18 secured to the lower part of the door section at the appropriate part thereof, said roller 16 being adapted 30 to engage a track 19 which extends along the length of the door opening and is so disposed in a channel that the upper surface thereof will lie flush or substantially flush with the floor or other surface.

35 In known manner the leaf at the outer end of each folding door section is hingedly connected to a fixed door post or the like, designated 20, while the leaf at the inner end of each section is hingedly 40 connected with an independent movable door post or mullion 21, hereinafter referred to as a mullion, which latter is adapted to slide with the leaves between the upper and lower tracks. While the 45 leaves of each folding section will be maintained vertical in one plane due to the co-operation of the swivelling rollers or the like with the upper and lower tracks there is a tendency, on opening or closing of 50 each section for the mullion 21 and the associated leaves to tilt or cant in the other vertical plane due to unequal movement between the top and bottom of the section. It is one object of the invention to overcome 55 this difficulty and to ensure equal simultaneous movement of the upper and lower parts of each door section on movement thereof in one direction or the other, and for this purpose a system of bracing 60 is provided in respect of each door section, such systems being clearly shown in Figure 4. As will be seen from that Figure, two pulleys 22 and 23 are mounted at the upper part of each mullion 21, while 65 two further pulleys 24 and 25 are disposed at or adjacent the lower part of each mullion. Since both bracing systems are identical it will suffice to describe only one and for that purpose the system associated with the left hand section will now be 70 described. Suitably anchored to the left hand fixed door post 20 is a rope or cable 26 which is adapted to pass over a sheave or pulley 27 at the upper part of said door post and thence over the pulley 22 at the 75 upper part of the mullion 21 whence it passes downwardly around the pulley 24 at the lower part of said mullion, the other end of said rope or cable 26 being suitably anchored to a point at the extremity of movement of the mullion 21 as indicated at 28. A second rope or cable 29 is suitably anchored at one end to the fixed door post 20 and is adapted to pass round a pulley 30 at the lower part of said door post and thence over the pulley 25 at the 80 lower part of the mullion 21 whence it passes upwardly over the pulley 23 at the upper part of said mullion, the other end of said rope or cable 29 being suitably 85 anchored to a point at the extremity of movement of the mullion 21, as indicated at 31, and preferably in the same vertical plane as the second point of anchorage of the first rope or cable 26. Preferably suitable means are associated with the ropes or cables 26 and 29, in order to allow for adjustment of the tension thereon. By virtue of the disposition of the ropes or cables 26 and 29 a diagonal bracing system 90 is provided in respect of the folding section and any possibility of movement of the mullion 21 and hence of the appropriate leaves from the vertical during movement back and forth along the tracks 95 and at all other times will be prevented. As above indicated an identical bracing system is provided in respect of the right hand section. Instead of providing only two ropes or cables in the manner above 100 described it may be preferable to provide an independent and separate set of bracing ropes or cables at the upper and lower ends of each mullion. In this case two pairs of pulleys would be mounted at the upper 105 end of each mullion, one pair being disposed above the other while a similar arrangement would be provided at the lower part of said mullion. Considering now the upper end of one mullion one 110 rope or cable would be connected or anchored to the upper part of the appropriate fixed door post and would be led around one of the upper pulleys and then around one of the lower pulleys which are, 115 however, disposed at the upper part of the mullion, the other end of said rope or cable being suitably anchored at the extremity of movement of the mullion. The second 120 rope or cable would be suitably anchored 125 130

to the fixed door post at a point below the point of anchorage of the first and would pass around the second lowermost pulley and the upwardly over the second uppermost pulley, the other end being suitably anchored at the other extremity of movement of the mullion and preferably in line with the point of anchorage of the second end of the first rope or cable. An identical arrangement of ropes or cables would be provided at the lower part of the door and thus the arrangement previously described with reference to Figure 4 would in fact be duplicated separate and independent sets of bracing ropes or cables being provided in respect of both the upper and lower ends of each mullion. Here again suitable means would preferably be provided to allow for adjustment of the tension on the ropes or cables in order to ensure that the mullion and hence the leaves will be maintained absolutely vertical during movement and at all other times.

In the embodiment illustrated, each door section is driven backwards and forwards across the door opening by means of a separate tractor unit, each unit being associated with and mounted at the lower part of the appropriate mullion 21. In the embodiment illustrated, each tractor unit includes a pair of driving wheels or rollers 34 adapted to engage the floor or other surface at either side of the lower track on which the lower rollers associated with the leaves are adapted to run. The driving wheels or rollers 34 are keyed or otherwise suitably secured to a shaft 35 which is rotatably journaled in a pair of brackets 36 carried by a frame 37. The frame 37 is resiliently supported within the mullion, being suspended from a transverse bar or the like 38 by means of a plurality of rods 39 with which latter springs 40 are associated. Also mounted within the frame 37 is an electric driving motor 41 which is drivingly connected to a gear box 42 by means of a belt or chain drive, indicated generally at 43. The drive from the gear box 42 is transmitted by means of a suitable belt or chain drive 44 to a transverse shaft 45, whence a drive is transmitted to the shaft 35 by means of further belt or chain drive 46.

A manually operable drive is also provided in each tractor unit to effect operation of the door sections should the power operated means fail or should their use not be required, and in the embodiment illustrated a further shaft or spindle 47 is rotatably mounted within the frame 37, said spindle having an operating handle 48 associated therewith and the arrangement being such that on rotation of said shaft 47 a drive will be transmitted to the shaft

45 by virtue of the belt or chain drive 49, a drive from said shaft 45 being transmitted as before to the shaft 35 by the belt or chain drive 46. The current to the motor 41 may be supplied by providing suitable contactors or the like at the lower end of the mullion adapted to co-operate with the bus-bars or the like disposed in the channel in which the lower track is located or if desired leads may be taken from a suitable source of supply around a winding drum or the like to said motor, the arrangement being such that as the mullion moves the leads will be wound in or paid out according to the direction of movement of said mullion. Instead of providing a pair of driving wheels or rollers such as indicated at 34, each tractor unit may include a single wheel or roller mounted on the shaft 37 such wheel or roller having a central radially projecting rim or flange adapted to engage a track or channel in the floor or other surface which track or channel may also serve as the lower track on which the rollers associated with the leaves are adapted to run.

Again, instead of providing tractor units in the manner above described, the lower end of each mullion may be operatively connected in any suitable manner to an endless band or cable disposed in a channel or the like below the path of movement of the door, the arrangement being such that on a drive being imparted to one of a pair of drums carrying the band or cable, the mullion, and hence the leaves, will be moved in one direction or the other according to the direction of rotation of the drum. In another example an endless band carrying a plurality of transverse slats may be disposed in a channel or the like below the path of movement of each folding door section said band which is, for example, in the form of a known slat conveyor, being adapted to be driven in any suitable manner. The slat conveyor is preferably slightly longer than the path of movement of the folding section and a predetermined number of adjacent slats are adapted to carry an upstanding strip or the like substantially centrally thereof, the arrangement being such that when all or certain of the slats carrying the strips are in the same flight of the conveyor an upstanding rail will be formed which extends lengthwise along the conveyor. Said conveyor is so arranged that when in the upper flight the rail thus formed will provide a track on which the rollers or the like associated with the lower ends of the leaves of the folding section are adapted to run. The lower end of the appropriate mullion is connected to the slat conveyor in any suitable manner at a point adjacent one

end of the rail and the arrangement is such that if the section is in its retracted or folded position then on operation of the slat conveyor the mullion and hence the leaves will be moved across the door opening. As the conveyor moves along, those slats carrying the strips or the like will be caused to pass successively into the upper flight so that the rollers associated with the leaves will be caused to run on the rail thus formed. As above indicated the slat conveyor is preferably so constructed that only a certain number, for example half, of the slats will carry the strips or the like so that when the folding door section is in its retracted or folded position the channel or the like in which the conveyor is disposed will be closed by slats having a plane surface. The conveyor chain or band carrying the slats may be supported at spaced points by means of rollers or the like which are adapted to co-operate with suitably disposed rails or supports mounted in the channel.

25 The arrangement is preferably such that all parts, such as the pulleys 22—25, the tractor unit, and all other elements associated with each mullion will be totally enclosed therein, while the ropes or cables such as 26 and 29 may be disposed in separate channels or ducts at the upper and lower edges of the folding section, which channels or ducts may form the upper and lower tracks in which the rollers associated with the leaves are adapted to run.

The invention has been described above with reference to a door having two folding sections but it will be understood that in certain cases a single folding section or three or more of such sections may be present depending on the width of the opening which it is required to close. Further, in certain cases it may be feasible to mount the driving means at the upper part of each folding door section instead of at the bottom in the manner described and illustrated.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A folding door, partition or the like including one or more folding sections each formed of a plurality of hingedly connected leaves and adapted to be moved back and forth along a predetermined path to open or close an entrance or exit in which bracing ropes, cables, or the like are associated with each section, each rope or cable being anchored at its opposite ends and adapted between its points of anchorage to pass around sheaves, pulleys or the like carried by a movable door post or

mullion associated with the leaves in such a manner as to exert a diagonal bracing action on said mullion, the arrangement being such that the mullion and hence the associated leaves will be maintained vertical during movement and at all other times.

2. A folding door, partition or the like, as in Claim 1, in which two ropes, cables or the like are provided in respect of each folding section, one being anchored at one end to a fixed door post and adapted to pass around a pulley at the upper part of the mullion and hence downwardly around a pulley at the lower part of the latter to a point of anchorage at or adjacent the extremity of movement of said mullion while the second is anchored at one end to the fixed door post and passes around a pulley at the lower part of the mullion and thence upwardly around a pulley at the upper part of the latter to a point of anchorage at or adjacent the extremity of movement of the mullion and in the same vertical plane as the second point of anchorage of the first rope, cable, or the like.

3. A folding door, partition or the like, as in Claim 1, in which four ropes, cables, or the like are associated with each section to provide two separate opposed diagonal bracing systems, one at the upper and one at the lower part of the movable door post or mullion.

4. A folding door, partition or the like, as in any of the preceding claims, in which means are provided to allow for adjustment of the tension on the ropes, cables, or the like.

5. A folding door, partition or the like, as in any of the preceding claims, in which power operated driving means are associated with each section for driving the latter back and forth across the entrance or exit.

6. A folding door, partition or the like, as in Claim 5, in which the power operated means comprise a driving or tractor unit which is mounted within the movable door post or mullion and includes one or more driving wheels or rollers adapted to run on the floor or other surface or on a track disposed in said floor or other surface.

7. A folding door, partition or the like, as in Claim 6, in which the driving or tractor unit which includes a driving motor is resiliently mounted within the mullion and is provided with a pair of driving wheels or rollers so disposed as to run on the floor or other surface at either side of a track or the like with which latter rollers or the like associated with the hinged leaves are adapted to co-operate.

8. A folding door, partition or the like, as in Claims 5 to 7, in which in addition

to the power operated means manually operated means are provided for effecting movement of each folding section.

9. A folding door, partition or the like  
5 constructed, arranged, and adapted to operate substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 15th day of August, 1940.

HASELTINE, LAKE & CO.,  
28, Southampton Buildings,  
London, England, and  
19—25, West 44th Street, New York,  
U.S.A.,  
Agents for the Applicants.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1941.

[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 1.

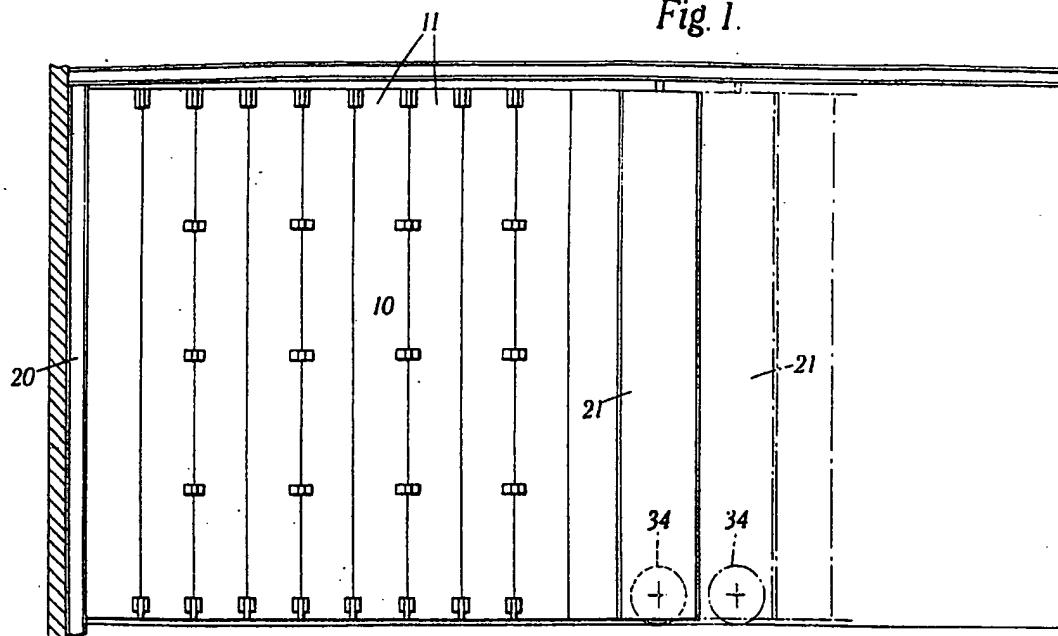


Fig. 2.

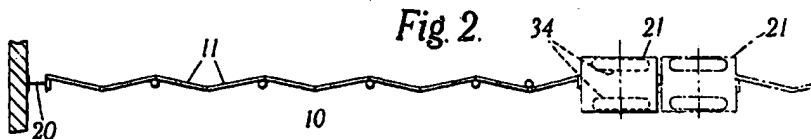
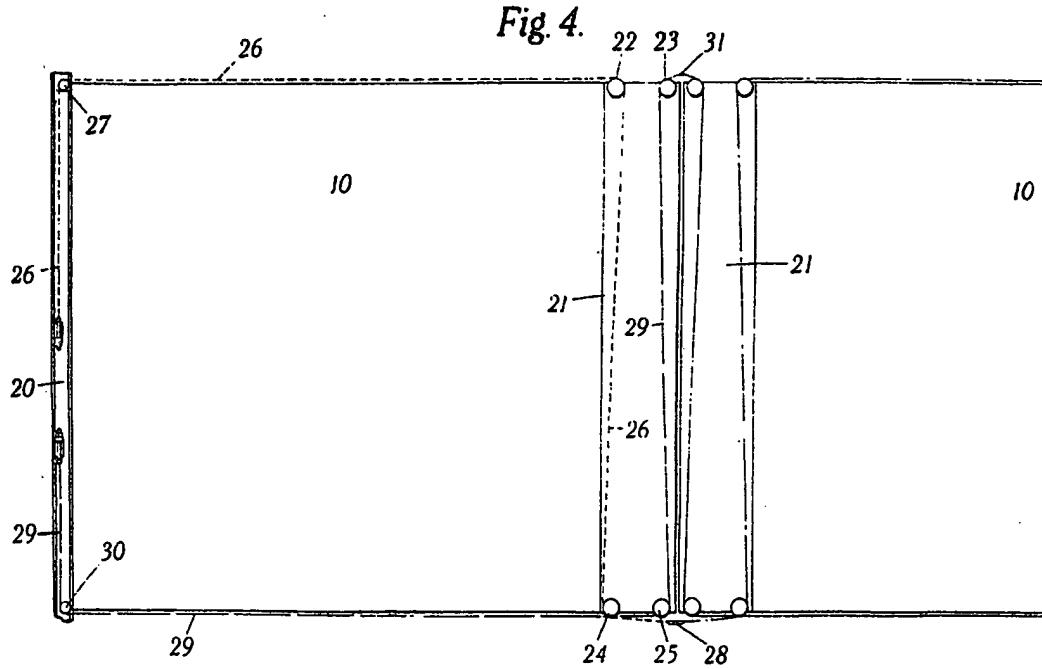


Fig. 4.



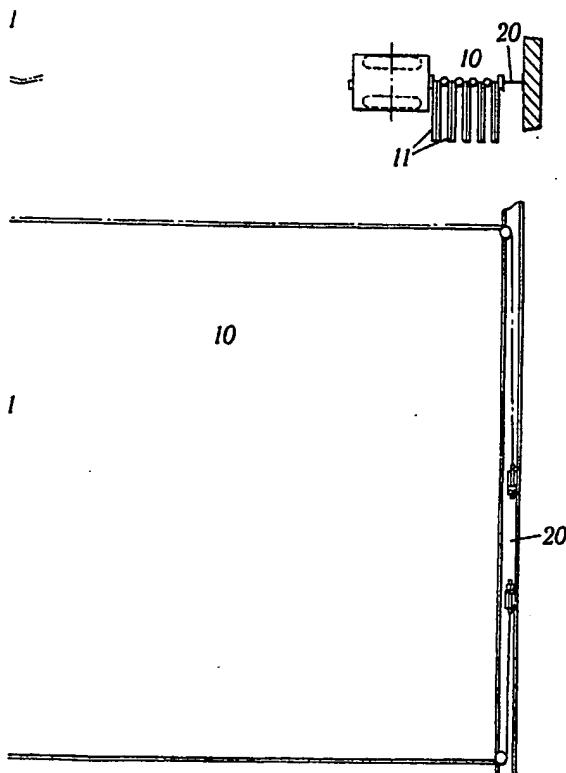
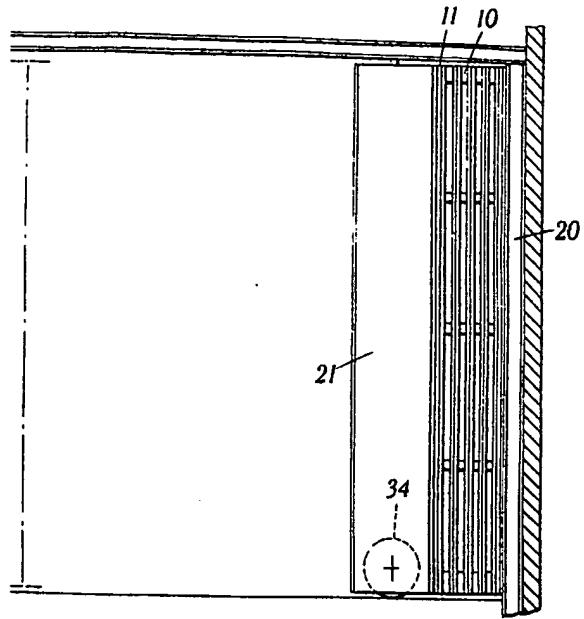


Fig. 3.

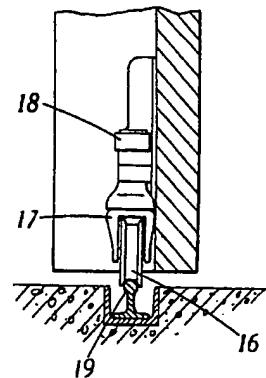
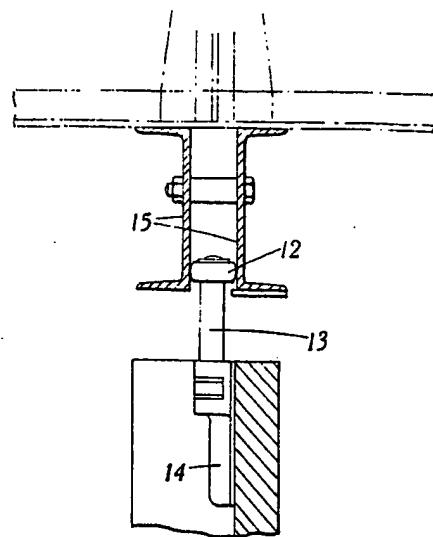


Fig. 1.

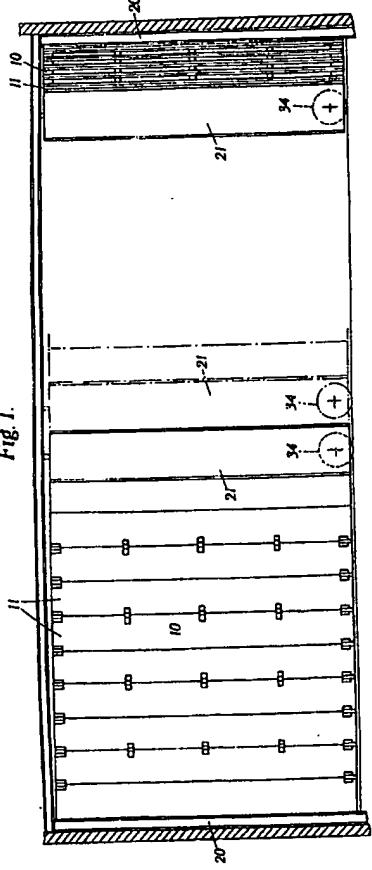


Fig. 3.

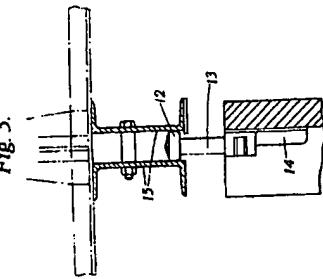


Fig. 2.

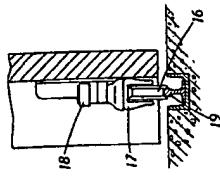
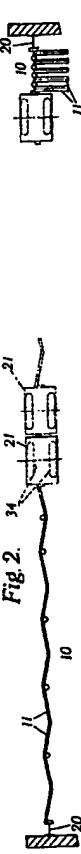
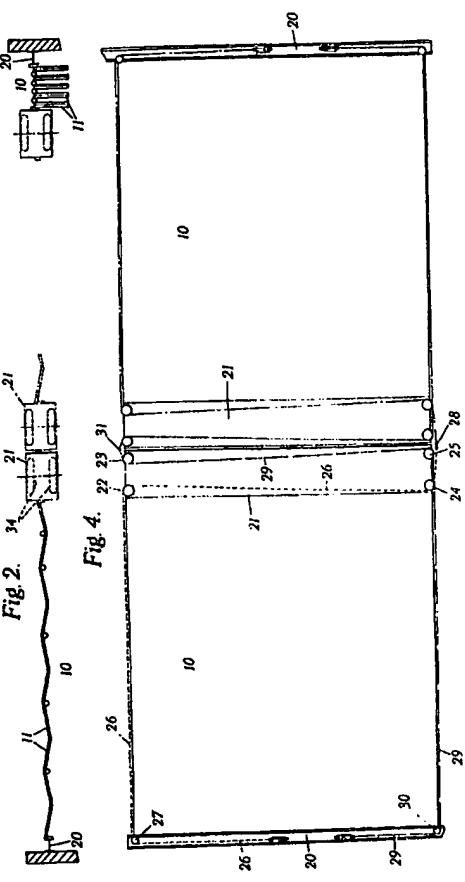


Fig. 4.



(This Drawing is a reproduction of the Original on a reduced scale.)

Fig. 5.

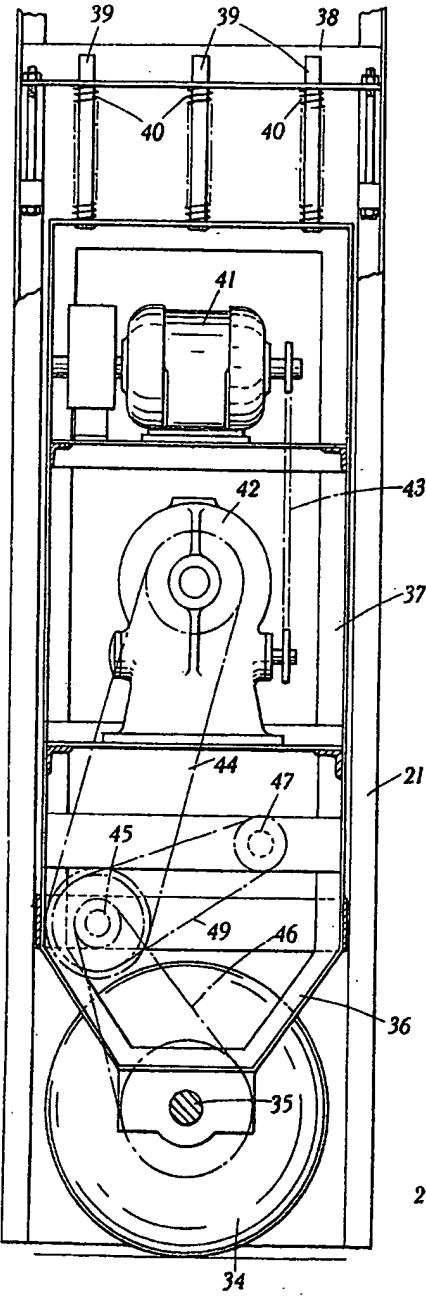
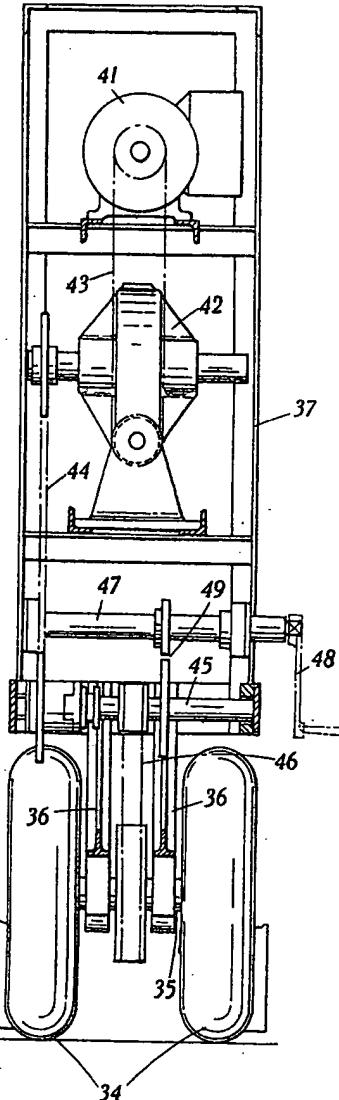


Fig. 6.



*[This Drawing is a reproduction of the Original on a reduced scale.]*